

WHAT IS CLAIMED IS:

1. A multi-beam scanning optical apparatus
comprising:

incident optical means for making a plurality of
5 light beams emitted from light source means having a
plurality of light emitting portions incident on
deflection means; and

scanning optical means for forming images of the
plurality of light beams deflected by said deflection
10 means on a surface to be scanned,

wherein said scanning optical means has at least
one scanning optical element made of a resin, and said
scanning optical element made of the resin has
birefringence due to a stress distribution generated
15 upon cooling in a molding process thereof such that the
directions of principal axes of birefringence at one
end portion of said scanning optical element made of
the resin are different from those at the other end
portion, opposite to said one end portion with respect
20 to an optical axis thereof in a main scanning
direction, of said scanning optical element made of the
resin, and

wherein an interval between adjacent scanning
lines of scanning lines formed on the scanning surface
25 by the plurality of light beams whose images are formed
on the scanning surface through said scanning optical
element made of the resin changes in the main scanning

direction in an effective scanning region, and

wherein said apparatus comprises at least one
setting means for setting a sub-scanning interval error
between the scanning lines due to a polarization angle
5 difference between the light beams emitted from the
plurality of light emitting portions to be not more
than 1/5 of a desired scanning line interval.

2. An apparatus according to claim 1, wherein the
10 direction of the principal axes of the birefringence at
the end portions of said scanning optical element made
of the resin form an asymmetrical distribution due to
the stress distribution generated upon cooling in the
molding process of said scanning optical element made
15 of the resin.

3. An apparatus according to claim 1, wherein
said apparatus has a plurality of scanning optical
elements made of the resin.

4. An apparatus according to claim 1, wherein
said scanning optical means includes refractive optical
elements all of which are scanning optical elements
made of a resin.

5. An apparatus according to claim 1, wherein
said scanning optical means includes a scanning optical

element made of glass.

6. An apparatus according to claim 1, wherein
said scanning optical means includes a reflecting
5 optical element having a power.

7. An apparatus according to claim 1, wherein
said setting means sets the polarization angle
difference between the light beams emitted from the
10 plurality of light emitting portions to be not more
than 20°.

8. An apparatus according to claim 1, wherein
said setting means comprises correction means for
15 correcting the polarization angle difference between
the plurality of light beams incident on said scanning
optical element made of the resin.

9. An apparatus according to claim 8, wherein
20 said correction means comprises polarized light
limiting means inserted into an optical path between
the light source means and said scanning optical
element made of the resin.

10. An apparatus according to claim 9, wherein
said polarized light limiting means is tilted with
respect to the optical axis of said incident optical

means.

11. An apparatus according to claim 1, wherein the plurality of light emitting portions are independently
5 arranged.

12. An apparatus according to claim 11, wherein said setting means comprises adjustment means capable of independently adjusting polarization angles of the
10 light beams emitted from the plurality of light emitting portions.

13. An apparatus according to claim 1, wherein the light source means comprises a monolithic multi-beam
15 light source.

14. An apparatus according to claim 13, wherein said apparatus has a plurality of monolithic multi-beam light sources.
20

15. An apparatus according to claim 14, wherein said setting means comprises adjustment means capable of independently adjusting polarization angles of the light beams emitted from the plurality of monolithic
25 multi-beam light sources.

16. An apparatus according to claim 1, wherein

said setting means comprises a scanning optical element made of a resin, which is shift-decentered perpendicularly to a sub scanning direction and/or rotary-decentered about the main scanning direction.

5

17. An apparatus according to claim 1, wherein letting h be a sub-scanning width of said scanning optical element made of the resin and d be an optical-axis-direction width, $h/d \leq 1.8$ is satisfied.

10

18. An apparatus according to claim 1, wherein letting h be a sub-scanning width of said scanning optical element made of the resin and t be a sub-scanning width of the light beam passing through said scanning optical element made of the resin, $h/t \leq 15$ is satisfied.

15

19. An image forming apparatus comprising:

20

said multi-beam scanning optical apparatus of any one of claims 1 to 18;

a photosensitive member disposed in the scanning surface;

25

a developer for developing, as a toner image, an electrostatic latent image formed on said photosensitive member by light beams scanned by said multi-beam scanning optical apparatus;

a transfer device for transferring the developed

toner image onto a transfer member; and

a fixing device for fixing the transferred toner image on the transfer member.

5 20. An image forming apparatus comprising:

said multi-beam scanning optical apparatus of any one of claims 1 to 18; and

10 a printer controller for converting code data received from an external device into an image signal and inputting the image signal to said scanning optical apparatus.

21. A multi-beam scanning optical apparatus comprising:

15 incident optical means for making a plurality of light beams emitted from light source means having a plurality of light emitting portions incident on deflection means; and

20 scanning optical means for forming images of the plurality of light beams deflected by said deflection means on a surface to be scanned,

25 wherein said scanning optical means has at least one scanning optical element made of a resin, and said scanning optical element made of the resin has birefringence due to a stress distribution generated upon cooling in a molding process thereof such that the directions of principal axes of birefringence at one

09064658 092801

end portion of said scanning optical element made of
the resin are different from those at the other end
portion, opposite to said one end portion with respect
to an optical axis thereof in a main scanning
5 direction, of said scanning optical element made of the
resin, and

wherein an interval between adjacent scanning
lines of scanning lines formed on the scanning surface
by the plurality of light beams whose images are formed
10 on the scanning surface through said scanning optical
element made of the resin changes in the main scanning
direction in an effective scanning region, and

said apparatus comprises at least one setting
means for setting a sub-scanning interval error between
15 the scanning lines due to a polarization angle
difference between the light beams emitted from the
plurality of light emitting portions to be not more
than 1/5 of a desired scanning line interval,

said setting means setting the polarization angle
20 difference between the light beams emitted from the
plurality of light emitting portions to be not more
than 20° .

22. An image forming apparatus comprising:

25 said multi-beam scanning optical apparatus of
claim 21;

a photosensitive member disposed in the scanning

surface;

a developer for developing, as a toner image, an
electrostatic latent image formed on said
photosensitive member by light beams scanned by said
5 multi-beam scanning optical apparatus;

a transfer device for transferring the developed
toner image onto a transfer member; and

a fixing device for fixing the transferred toner
image on the transfer member.

10

23. An image forming apparatus comprising:

said multi-beam scanning optical apparatus of
claim 21; and

a printer controller for converting code data
15 received from an external device into an image signal
and inputting the image signal to said scanning optical
apparatus.

24. A multi-beam scanning optical apparatus
20 comprising:

incident optical means for making a plurality of
light beams emitted from light source means having a
plurality of light emitting portions incident on
deflection means; and

25 scanning optical means for forming images of the
plurality of light beams deflected by said deflection
means on a surface to be scanned,

092801 092801 092801 092801 092801 092801 092801 092801 092801 092801

wherein said scanning optical means has at least one scanning optical element made of a resin, and said scanning optical element made of the resin has birefringence due to a stress distribution generated upon cooling in a molding process thereof such that the directions of principal axes of birefringence at one end portion of said scanning optical element made of the resin are different from those at the other end portion, opposite to said one end portion with respect to an optical axis thereof in a main scanning direction, of said scanning optical element made of the resin, and

wherein an interval between adjacent scanning lines of scanning lines formed on the scanning surface by the plurality of light beams whose images are formed on the scanning surface through said scanning optical element made of the resin changes in the main scanning direction in an effective scanning region, and

said apparatus comprises at least one setting means for setting a sub-scanning interval error between the scanning lines due to a polarization angle difference between the light beams emitted from the plurality of light emitting portions to be not more than $1/5$ of a desired scanning line interval,

said setting means comprising correction means for correcting the polarization angle difference between the plurality of light beams incident on said scanning

optical element made of the resin.

25. An apparatus according to claim 24, wherein
said setting means comprises adjustment means capable
5 of independently adjusting polarization angles of the
light beams emitted from the plurality of light
emitting portions.

26. An apparatus according to claim 24, wherein
10 said setting means comprises polarized light limiting
means inserted into an optical path between the light
source means and said scanning optical element made of
the resin.

27. An image forming apparatus comprising:
15 said multi-beam scanning optical apparatus of
claim 24;
a photosensitive member disposed in the scanning
target surface;
20 a developer for developing, as a toner image, an
electrostatic latent image formed on said
photosensitive member by light beams scanned by said
multi-beam scanning optical apparatus;
a transfer device for transferring the developed
25 toner image onto a transfer member; and
a fixing device for fixing the transferred toner
image on the transfer member.

28. An image forming apparatus comprising:

said multi-beam scanning optical apparatus of
claim 24; and

5 a printer controller for converting code data
received from an external device into an image signal
and inputting the image signal to said scanning optical
apparatus.

29. A multi-beam scanning optical apparatus
10 comprising:

incident optical means for making a plurality of
light beams emitted from light source means having a
plurality of light emitting portions incident on
deflection means; and

15 scanning optical means for forming images of the
plurality of light beams deflected by said deflection
means on a surface to be scanned,

wherein said scanning optical means has at least
one scanning optical element made of a resin, and said
20 scanning optical element made of the resin has
birefringence due to a stress distribution generated
upon cooling in a molding process thereof such that the
directions of principal axes of birefringence at one
end portion of said scanning optical element made of
25 the resin are different from those at the other end
portion, opposite to said one end portion with respect
to an optical axis thereof in a main scanning

0096463-09201
T02250-0349660

direction, of said scanning optical element made of the resin, and

wherein an interval between adjacent scanning lines of scanning lines formed on the scanning surface by the plurality of light beams whose images are formed on the scanning surface through said scanning optical element made of the resin changes in the main scanning direction in an effective scanning region, and

said apparatus comprises at least one setting means for setting a sub-scanning interval error between the scanning lines due to a polarization angle difference between the light beams emitted from the plurality of light emitting portions to be not more than 1/5 of a desired scanning line interval,

said setting means comprising a scanning optical element made of a resin, which is shift-decentered perpendicularly to a sub scanning direction and/or rotary-decentered about the main scanning direction.

30. An image forming apparatus comprising:

said multi-beam scanning optical apparatus of claim 29;

a photosensitive member disposed in the scanning surface;

a developer for developing, as a toner image, an electrostatic latent image formed on said photosensitive member by light beams scanned by said

a fixing device for fixing the transferred toner image on the transfer member.

a printer controller for converting code data received from an external device into an image signal and inputting the image signal to said scanning optical apparatus.

wherein said scanning optical means has at least one scanning optical element made of a resin, and said scanning optical element made of the resin has birefringence due to a stress distribution generated

upon cooling in a molding process thereof such that the directions of principal axes of birefringence at one end portion of said scanning optical element made of the resin are different from those at the other end portion, opposite to said one end portion with respect to an optical axis thereof in a main scanning direction, of said scanning optical element made of the resin, and

wherein an interval between adjacent scanning lines of scanning lines formed on the scanning surface by the plurality of light beams whose images are formed on the scanning surface through said scanning optical element made of the resin changes in the main scanning direction in an effective scanning region, and

said apparatus comprises at least one setting means for setting an actual sub-scanning interval error between the scanning lines on the scanning surface to be smaller than the sub-scanning interval error between the scanning lines on the scanning surface, caused by a relative displacement in polarization angle between the light beams emitted from the plurality of light emitting portions,

said setting means comprising a scanning optical element made of a resin, which is shift-decentered perpendicularly to a sub scanning direction and/or rotary-decentered about the main scanning direction.

deflection means; and

scanning optical means for forming images of the plurality of light beams deflected by said deflection means on a surface to be scanned,

5 wherein said scanning optical means has at least one scanning optical element made of a resin, and said scanning optical element made of the resin has birefringence due to a stress distribution generated upon cooling in a molding process thereof such that the
10 directions of principal axes of birefringence at one end portion of said scanning optical element made of the resin are different from those at the other end portion, opposite to said one end portion with respect to an optical axis thereof in a main scanning
15 direction, of said scanning optical element made of the resin, and

 wherein an interval between adjacent scanning lines of scanning lines formed on the scanning surface by the plurality of light beams whose images are formed
20 on the scanning surface through said scanning optical element made of the resin changes in the main scanning direction in an effective scanning region, and

 said apparatus comprises at least one setting means for setting an actual sub-scanning interval error
25 between the scanning lines on the scanning target surface to be smaller than the sub-scanning interval error between the scanning lines on the scanning

and inputting the image signal to said scanning optical apparatus.

09564633 092301